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EXAMINER	
GODBOLD, DOUGLAS	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/724,008	LIU ET AL.
	Examiner	Art Unit
	Douglas C. Godbold	2626

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 November 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *26 November 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *See Continuation Sheet*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :20040422, 20040712, 20050531, 20060307, 20060327, 20060728, 20060901, 20061129, 20070308, 20070320 .

DETAILED ACTION

1. This action is in response to application 10/724,008 filed on November 26, 2003. Claims 1-29 are pending in the application and have been examined.

Information Disclosure Statement

2. The information disclosure statements filed April 4, 2004, July 12, 2004, May 31, 2005, March 7, 2006, March 27, 2006, July 28, 2006, September 1, 2006, November 29, 2006, March 8, 2007, and March 20, 2007 have been considered in this office action.

Claim Rejections - 35 USC § 101

3. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

4. Claims 14-29 rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claims 14-29 attempt to claim a computer readable medium. However, in the Specification, computer readable medium is defined as either a storage media or a communications media. Further communications media is defined to include items such as magnetic carrier waves, an item considered non-statutory under 35 U.S.C. 101. Therefore claims 14-29 are rejected under 35 U.S.C. 101.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 14, 19, and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by Park et al (US Patent 5,590,241).

7. Consider claim 14, Park teaches a computer-readable medium having computer-executable instructions (figure 1, implemented on computer readable medium; column 8 line 25,) for performing steps comprising:

receiving an alternative sensor signal from an alternative sensor that is not an air conduction microphone (figure 1, output of accelerometer 34); and

using the alternative sensor signal to estimate a clean speech value without using a model trained from noisy training data (input from 31) collected from an air conduction microphone (enhanced speech signal is outputted from adaptive filter which is adjusted in part using the estimation error. The filter is adapted in real time using the estimation error, not trained with noisy training data.)

8. Consider claim 19, Park teaches the computer-readable medium of claim 14 further comprising receiving a noisy test signal from an air conductive microphone and using the noisy test signal with the alternative sensor signal to estimate the clean speech value (Figure 1 shows a microphone 31 that picks up both noise 22 and voice 31. The noisy test signal is then added 38 to the output of the adaptive filter 37 [fed by the accelerometer 34], the sum being used to adjust the adaptive filter 37; Abstract.).

9. Consider claim 20, Park teaches the computer-readable medium of claim 19 wherein using the noisy test signal comprises generating a noise model from the noisy test signal (Summing device 38 has a positive input terminal for receiving MICROPHONE INPUT SIGNAL, a negative input terminal for receiving the ENHANCED SPEECH SIGNAL, and an output terminal for providing a signal labeled "ESTIMATION ERROR" to the error input of adaptive f9lter 37; column 3, line 50. The estimation error is in fact a noise estimate..)

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

12. Claims 1, 2, 5, and 6 rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art (APA).

13. Consider claim 1, the APA teaches a method of determining an estimate for a noise-reduced value representing a portion of a noise-reduced speech signal (Recently, a system has been developed that attempts to remove noise by using a combination of an alternative sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 line 25.), the method comprising:

generating an alternative sensor signal using an alternative sensor other than an air conduction microphone (This system is trained using three training channels: a noisy alternative sensor training signal... Specification page 2, line 28-30.);

converting the alternative sensor signal into at least one alternative sensor vector (Each of the digitized signal frames are converted into a feature domain; Specification page 3, line 2.); but does not specifically teach:

adding a correction vector to the alternative sensor vector to form the estimate for the noise-reduced value.

However the APA does suggest adding a correction vector to the alternative sensor vector to form the estimate for the noise-reduced value (Once trained, the mappings are applied to a noisy vector formed from a combination of a noisy alternative sensor test signal and a noisy air conduction microphone test signal. This mapping produces a clean signal vector; Specification page 3, lines 10-14. Spectral subtraction [or adding a negative] of the noise vector from noisy signal vector would have been the obvious way to do this to one of ordinary skill in the art at the time of the invention).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use spectral subtraction as a way of reducing the noise in a signal vector as a way to implement the noise reduction method of the APA, as this technique is well known in the art, eliminating the need for one to develop this part of the software on their own, reducing development costs.

14. Consider claim 2, the APA teaches the method of daim 1 wherein generating an alternative sensor signal comprises using a bone conduction microphone to generate the alternative sensor signal (Recently, a system has been developed that attempts to remove noise by using a combination of an alternative sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 lines 25-28.).

15. Consider claim 5, the APA teaches the method of daim 1 further comprising training a correction vector through steps comprising:

generating an alternative sensor training signal (This system is trained using three training channels: a noisy alternative sensor training signal... Specification page 2, lines 28-30.);

converting the alternative sensor training signal into an alternative sensor training vector (Each of the digital signals frames are converted into a feature domain; Specification page 3, lines 2-3.);

generating a clean air conduction microphone training signal (This system is trained using three training channels: a noisy alternative sensor training signal... and a clean air conduction signal; Specification page 2, line 28 – page 3 line 2.);

converting the clean air conduction microphone training signal into an air conduction training vector (Each of the digital signals frames are converted into a feature domain; Specification page 3, lines 2-3.); and

using the difference between the alternative sensor training vector and the air conduction training vector to form the correction vector (The features for the noisy alternative sensor signal and the noisy air conduction microphone signal are combined into a single vector representing a noisy signal. The features for the clean air conduction microphone signal form a single clean vector. These vectors are then used to train a mapping between the noisy vectors and the clean vectors; Specification page 3, lines 3-7).

16. Consider claim 6, the APA teaches the method of daim 5 wherein training a correction vector further comprises training a separate correction vector for each of a plurality of mixture components (The features for the noisy alternative sensor signal and the noisy air conduction microphone signal are combined into a single vector representing a noisy signal. The features for the clean air conduction microphone signal form a single clean vector. These vectors are then used to train a mapping between the noisy vectors and the clean vectors; Specification page 3, lines 3-5. This suggests each noisy vector is mapped to the clean vector in this step to determine the noise in each separate channel).

17. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over the APA in view of Frey et al (US PAP 2002/0173953.) and in further view of Zangi et al (US PAP 2004/0111258).

18. Consider claim 3, the APA teaches the method of daim 1, wherein combining a correction vector comprises combining a sum of a plurality of correction vectors (The features for the noisy alternative sensor signal and the noisy air conduction microphone signal are combined into a single vector representing a noisy signal. The features for the clean air conduction microphone signal form a single clean vector. These vectors are then used to train a mapping between the noisy vectors and the clean vectors; Specification page 3, line 3.), but does not teach specifically teach that the vectors are weighted, nor that when they are combined, they are added together

In the same field of noise reduction, Frey suggests weighting noise feature (figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. This could obviously be used as a weighting to when processing the signals further down.)

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply these same probability weightings that are suggested by Frey with the noise filtering scheme as taught by the APA in order to provide a method of filtering noise out of a signal that takes into consideration the probability that the signal component is in fact noise.

But this combination of the APA, and Frey does not teach adding a plurality of signal vectors together.

In the same field of noise reduction, Zangi teaches adding a plurality of signal vectors together (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the addition of vectors as taught by Zangi with the noise reduction of APA and Frey in order to provide a method of taking into consideration many different noise sources when reducing the noise levels in a signal.

19. Consider claim 4, the APA in view of Frey teaches the method of claim 3 wherein each correction vector corresponds to a mixture component and each weight applied to a correction vector is based on the probability of the correction vector's mixture

component given the alternative sensor vector (Figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. Each signal component could obviously be represented by a vector.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply these same probabilities that are taught by Frey with the noise filtering scheme as taught by the APA in order to provide a method of filtering noise out of a signals by determining the probability that it is in fact noise, thereby reducing the chance that the "clean" part of the signal is accidentally filtered out as well.

20. Claims 7-9, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over the APA in view of Zangi et al (US PAP 10/315,615).

21. Consider claim 7, the APA teaches the method of daim 1 but does not specifically teach generating a refined estimate of a noise-reduced value through steps comprising:

generating an air conduction microphone signal;

converting the air conduction microphone signal into an air conduction vector;

estimating a noise value;

subtracting the noise value from the air conduction vector to form an air conduction estimate;

combining the air conduction estimate and the estimate for the noise-reduced value to form the refined estimate for the noise-reduced value.

In the same field of noise reduction, Zangi teaches generating a refined estimate of a noise-reduced value (figure 4) through steps comprising:

generating an air conduction microphone signal (using microphone 26a);

converting the air conduction microphone signal into an air conduction vector (digital frames input to R[l] into signal processor 52);

estimating a noise value (The AP 72 includes the one or more AP filters 74a-74M; adaptive filters imply that an estimate a noise value is calculated. Zangi's adaptive filters operate by estimating a noise spectrum from a noisy signal spectrum and subtracting it from the noisy signal spectrum to produce a "clean" signal. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.);

subtracting the noise value from the air conduction vector to form an air conduction estimate (The AP 72 includes the one or more AP filters 74a-74M; paragraph 0090. Adaptive filters subtract a noise estimate from the noisy signal in order to estimate the signal);

combining the air conduction estimate and the estimate for the noise-reduced value to form the refined estimate for the noise-reduced value (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate.).

Therefore it would have been obvious to combine the refining techniques as taught by Zangi with the noise reduction method of the APA in order to provide a

method to dynamically change the adapting signals in order to improve the signal to noise ratio (Abstract, Zangi).

22. Consider claim 8, Zangi teaches the method of claim 7 wherein combining the air conduction estimate and the estimate for the noise-reduced value comprises combining the air conduction estimate and the estimate for the noise-reduced value in the power spectrum domain (The first processor filters are adapted in accordance with a noise power spectrum at the microphones and the second processor filter is adapted in accordance with a power spectrum of the intermediate output signal; paragraph 0019. Zangi's adaptive filter operates by estimating a noise spectrum from a noisy signal, spectrum and removing it from the noisy signal spectrum to produce a "clean" signal spectrum, usually by use of spectral subtraction. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.).

23. Consider claim 9, Zangi teaches the method of claim 8 further comprising using the refined estimate for the noise-reduced value to form a filter (Figure 5, the same filters are used as in figure 4, but the combined output is provided to adaptation processor 54 which intern updates the filters of processor 72.; paragraph 0094-0131).

24. Consider claim 11, the APA teaches the method of daim 1 further comprising:

generating an alternative sensor signal using a alternative sensor other than an air conduction microphone (This system is trained using three training channels: a noisy alternative sensor training signal... Specification page 2, line 28.);

converting the alternative sensor signal into at least one alternative sensor vector (Each of the signals is converted into a feature domain; Specification page 3, line 2.); and

adding a correction vector to the alternative sensor vector to form a estimate for the noise-reduced value (Once trained, the mappings are applied to a noisy vector formed from a combination of a noisy alternative sensor test signal and a noisy air conduction microphone test signal. This mapping produces a clean signal vector; Specification page 3, line 10.).

But the APA does not specifically teach that the sensor, signal, vector, estimate and correction value is a second sensor, signal, vector, estimate and correction value, nor combining the estimate for the noise-reduced value with the second estimate for the noise-reduced value to form a refined estimate for the noise-reduced value.

In the same field of noise reduction, Zangi teaches using multiple sensors, signals, and clean signal estimation (figure 4, microphones 26a-26m, filters 74a-74m and signals associated with), and combining a second corrected estimate with another corrected signal estimate (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the multiple clean signal estimates as taught by Zangi with the noise reduction system of the APA in order to provide a method to dynamically change the adapting signals in order to improve the signal to noise ratio (abstract Zangi).

25. Claims 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over the APA.

26. Consider claim 10, the APA teaches the method of claim 1 but does not teach forming the estimate for the noise-reduced value comprises forming the estimate without estimating noise.

However the APA does teach that a clean microphone vector is collected when estimating the noise- reduced value. This clean value can be used as a estimated noise reduced value, negating the need to estimate the noise.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to form an estimate of the noise reduced spectrum as taught by the APA without estimating the noise in order to avoid unnecessary computation.

27. Claims 12, 13, 15, and 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al (US Patent 5,590,241) in view of the APA.

28. Consider claim 12, Park teaches a method of determining an estimate of a clean speech value (using figure 1), the method comprising:

receiving an alternative sensor signal from a sensor other than an air conduction microphone (output of accelerometer 34.);

receiving an air conduction microphone signal from an air conduction microphone (output of microphone 31.);

identifying a pitch for a speech signal based on the alternative sensor signal (accelerometer 34 produces a signal which has primarily low-frequency speech components; column 3, line 21.); but does not teach specifically:

using the pitch to decompose the air conduction microphone signal into a harmonic component and a residual component; and

using the harmonic component and the residual component to estimate the clean speech value.

In the same field of noise reduction the APA teaches using the pitch to decompose the air conduction microphone signal into a harmonic component and a residual component and using the harmonic component and the residual component to estimate the clean speech value (One system or the prior art for estimating the noise in a speech signal uses the harmonics of human speech. The harmonics of human speech produce peaks in the frequency spectrum. By identifying nulls between these peaks, these systems identify the spectrum of the noise. This spectrum is then subtracted from the spectrum of the noisy speech signal to provide a clean speech signal; Specification, page 2, lines 3-10.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the harmonic separation scheme in conjunction with the signal cleaning method of Park, as the accelerometer would in fact provide a great estimation of the harmonics of the voiced speech.

29. Consider claim 13, Park in view of the embodiment of the APA used in claim 12 teaches the method of claim 12 but does not specifically teach wherein receiving an alternative sensor signal comprises receiving an alternative sensor signal from a bone conduction microphone.

In the same field of noise reduction, a different embodiment of the APA teaches receiving an alternative sensor signal from a bone conduction microphone (Recently, a system has been developed that attempts to remove noise by using a combination of an alternative sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 lines 25-28.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a bone conduction microphone as taught by the APA in lieu of the accelerometer as taught by Park, as the resulting signal would be substantially similar in nature.

30. Consider claim 15, Park teaches the computer-readable medium of claim 14 but does not teach specifically wherein receiving an alternative sensor signal comprises receiving a sensor signal from a bone conduction microphone.

In the same field of noise reduction, the APA teaches receiving an alternative sensor signal from a bone conduction microphone (Recently, a system has been developed that attempts to remove noise by using a combination of an alternative sensor, such as a bone conduction microphone, and an air conduction microphone, Specification page 2 lines 25-28.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a bone conduction microphone as taught by the APA in lieu of the accelerometer as taught by parks, as the resulting signal would be substantially similar in nature.

31. Consider claim 25, Park teaches the computer-readable medium of claim 14 and that frequency information can be obtained from the alternative sensor (accelerometer 34 produces a signal which has primarily low-frequency speech components; column 3, lines 9-30.) but does not specifically teach wherein using the alternative sensor signal to estimate a clean speech value further comprises:

determining a pitch for a speech signal and using the pitch to estimate the clean speech value.

In the same field of noise removal, the APA teaches determining a pitch for a speech signal and using the pitch to estimate the clean speech value. (One system or the prior art for estimating the noise in a speech signal uses the harmonics of human speech. The harmonics of human speech produce peaks in the frequency spectrum. By identifying nulls between these peaks, these systems identify the spectrum of the noise.

This spectrum is then subtracted from the spectrum of the noisy speech signal to provide a clean speech signal; Specification, page 2, lines 3-10.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the harmonic separation scheme in conjunction with the signal cleaning method of Park, as the accelerometer would in fact provide a great estimation of the harmonics of the voiced speech.

32. Consider claim 26, the APA teaches the computer-readable medium of claim 25 wherein using the pitch to estimate the clean speech value comprises:

receiving a noisy test signal from an air conduction microphone and decomposing the noisy test signal into a harmonic component and a residual component based on the pitch (One system or the prior art for estimating the noise in a speech signal uses the harmonics of human speech. The harmonics of human speech produce peaks in the frequency spectrum. By identifying nulls between these peaks, these systems identify the spectrum of the noise, page 2, lines 3-8. This could alternatively be done on the signal from the air conduction microphone.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to decompose the signal into harmonics as taught by the APA in order to more easily identity speech characteristics in a signal.

33. Consider claim 27, the APA teaches the computer-readable medium of claim 26 further comprising using the harmonic component and the residual component to

estimate the clean speech value (This spectrum is then subtracted from the spectrum of the noisy speech signal to provide a clean speech signal; Specification, page 2, lines 3-10.).

34. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park.

35. Consider claim 16, Park teaches the computer-readable medium of claim 14 wherein using the alternative sensor signal to estimate a clean speech value comprises:

converting the alternative sensor signal into at least one alternative sensor vector (ADC 36 converts the analog signal into a vector of time samples); but does not specifically teach:

adding a correction vector to an alternative sensor vector.

However Parks does suggest adding a correction vector to an alternative sensor vector (adaptive filter 37 corrects error in the signal of the alternative filter by adjusting the value of the samples, removing the estimated noise component. The transfer function of an adaptive filter can be viewed as adding a correction vector.)

36. Claims 17, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Frey in further view of Zangi.

37. Consider claim 17, Parks teaches the computer-readable medium of claim 16 but does not specifically teach wherein adding a correction vector comprises adding a

weighted sum of a plurality of correction vectors, each correction vector being associated with a separate mixture component.

In the same field of noise reduction, Frey teaches using probability to assign a score to determine if a signal is noise or not. (Figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. Each signal component could obviously be represented by a vector.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply these same probabilities that are taught by Frey with the noise filtering scheme as taught by the APA in order to provide a method of filtering noise out of a signal, based on the probability that a signal is a noise, in order to avoid a desired content of a signal from being filtered out.

But this combination of the Park, and Frey does not teach adding a plurality of signal vectors together.

In the same field of noise reduction, Zangi teaches adding a plurality of signal vectors together (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the addition of vectors as taught by Zangi with the noise reduction of Park and Frey in order to provide a method of taking into consideration many different noise sources when reducing the noise levels in a signal.

Consider claim 18, Frey teaches the computer-readable medium of claim 17 wherein adding a weighted sum of a plurality of correction vectors comprises using a weight that is based on the probability of a mixture component given the alternative sensor vector. (Figure 4, shows the determining of the probability and variance of the mixture components of signals in order to determine if they are noise signals or not. Each digital signal frame component is represented by a vector.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to apply these same probabilities that are taught by Frey with the noise filtering scheme as taught by Park in order to provide a method of filtering noise out of a signals by determining the probability that it is in fact noise, thereby reducing the chance that the "clean" part of the signal is accidentally filtered out as well.

38. Claims 21-24, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Zangi.

39. Consider claim 21, Park teaches the computer-readable medium of claim 20 wherein using the noisy test signal further comprises:

converting the noisy test signal (from 31) into at least one noisy test vector (output of microphone 31 fed to ADC 33, covering signal to a vector of digital samples.);

but does not specially teach subtracting a mean of the noise model from the noisy test vector to form a difference ; and

using the difference to estimate the clean speech value.

In the same field of noise reduction, Zangi teaches subtracting a mean of the noise model from the noisy test vector to form a difference (Figure 4, the AP 72 includes the one or more AP filters 74a-74M; paragraph 0090. Adaptive filters operate by estimating a noise spectrum from a noisy signal and removing it from the noisy signal to produce a "clean" signal, usually by use of spectral subtraction. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.); and

using the difference to estimate the clean speech value (the difference signal of noise+signal and noise would inherently be an estimated clean speech value.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the filtering method of parks with the signal from the air transducing microphones as taught by Zangi in order to provide a robust method of cleaning a signal from a standard microphone.

40. Consider claim 22, Park in view of Zangi teaches the computer-readable medium of claim 21 further comprising:

forming an alternative sensor vector from the alternative sensor signal (Park, ADC 36 converts the analog signal into a vector of time samples);

adding a correction vector to the alternative sensor vector to form an alternative sensor estimate of the clean speech value (Park, adaptive filter 37 filters the signal to produce a clean estimate. Filtering a signal is analogous to adding a corrective vector to it.); and

determining a weighted sum of the difference and the alternative sensor estimate to form the estimate of the clean speech value estimate (Zangi, he outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate. Although Zangi doesn't teach mixing the estimate from an alternative transducer, one of ordinary skill in the art could appreciate that if the information was available it would be obvious to use it in combination with the other estimated clean values, as this input device of this algorithm has little to do with its effectiveness. Combining more estimates from any kind of transducer would improve the final resultant estimate.)

41. Consider claim 23, Zangi teaches the computer-readable medium of claim 22 wherein the estimate of the clean speech value is in the power spectrum domain (The first processor filters are adapted in accordance with a noise power spectrum at the microphones and the second processor filter is adapted in accordance with a power spectrum of the intermediate output signal; paragraph 0019. Zangi's adaptive filter operates by estimating a noise spectrum from a noisy signal spectrum and removing it from the noisy signal spectrum to produce a "clean" signal spectrum, usually by use of spectral subtraction. The noise spectrum is adaptively estimated, that being the main advantage to this type of filter.).

42. Consider claim 24, Zangi teaches the computer-readable medium of claim 23 further comprising using the estimate of the clean speech value to form a filter (Figure 5,

the same filters are used as in figure 4, but the combined output is provided to adaptation processor 54 which intern updates the filters of processor 72; paragraphs 0094-0131).

43. Consider claim 29 Park teaches the computer-readable medium of claim 14 further comprising:

receiving a alternative sensor signal from a alternative sensor that is not an air conduction microphone (figure 1, output of accelerometer 34); but does not specifically teach a second alternative sensor signal and sensor nor using the second alternative sensor signal with the first alternative sensor signal to estimate the clean speech value.

In the same field of noise reduction, Zangi teaches using multiple sensors (figure 4, microphones 26a-26m, filters 74a-74m and signals associated with), and using the second alternative sensor signal with the alternative sensor signal to estimate the clean speech value (The outputs of the one or more AP filters 74a-74M are coupled to the combiner circuit 76; paragraph 0090. This is combining several estimates to form one refined estimate. Although Zangi doesn't teach alternative sensors, one of ordinary skill in the art can appreciate that the same algorithm can be applied to alternative sensors.).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the multiple clean signal estimates as taught by Zangi with the noise reduction system of Park in order to provide a method to dynamically change the adapting signals in order to improve the signal to noise ratio (abstract Zangi). It is also clear that the input to the algorithm of Zangi would have little effect on its

effectiveness. Combining more estimates from any transducers would improve the final resultant estimate.

44. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al.

45. Consider claim 28, Park teaches the computer-readable medium of claim 14 but does not specifically teach wherein estimating a clean speech value further comprises not estimating noise.

However one of ordinary skill in the art at the time of the invention could appreciate that if the system of figure 1 was operated in a quite environment (i.e. no noise 22) the estimation error signal would then become only a difference signal, with no noise.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to operate the system of figure 1 in a noiseless environment to better adapt the filter 37 that operates on the signal from the accelerometer, compensating only for the difference in the signal from the accelerometer and the actual audio signal.

Conclusion

46. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure can be found on the Notice of References Cited.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas C. Godbold whose telephone number is (571) 270-1451. The examiner can normally be reached on Monday-Thursday 7:00am-4:30pm Friday 7:00am-3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Edouard can be reached on (571) 272-7603. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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